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Remarks

Reconsideration of this Application is respectfully requested. Upon entry of the foregoing amendment, claims 161-164, 166-170 and 172-182 are pending in the application, with 161, 169 and 175 being the independent claims. Claims 165 and 171 are sought to be cancelled without prejudice to or disclaimer of the subject matter contained therein. Claims 161, 162, 166, 167, 169, 172 and 175-178 are sought to be amended. Support for inclusion in the claims of the recitation "one or more ionomers" can be found, for example, in the previously presented claims as well as in the specification at page 16, line 28 to page 17, line 1; page 17, lines 11-13; and page 18, line 16-24. Support for the amendment to claim 161 changing the weight percent range of the tackifier can be found in the specification, for example, at page 38, lines 9-10. Amendments have also been made to claim 167 to include generic terminology of trademark terms (i.e., AQ1045, AQ1350, AQ1950, AQ14000). Support for the generic terminology can be found in Exhibit A, filed herewith. Exhibit A provides generic descriptions and inherent properties of the trademark terms. Support for the amendment to claim 175 changing the weight percentage range of the polar carrier can be found in the specification, for example, at page 31, lines 6-14. Support for new claims 181 and 182 can be found in the specification, for example, from pages 18-26, or in the original or previously presented claims. Support for all other changes can be found, for example, in the original or previously presented claims. Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

I. Double Patenting Rejections

Claims 161-166 and 169-172 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-2, 4-5, 7, and 12-13 of U.S. Patent No. 6,600,142. Office Action, pages 2-3. Applicants respectfully request that this rejection be held in abeyance until all other issues are resolved.

II. Claim Rejections Under 35 U.S.C. § 103

Claims 175-177 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jones *et al.* (U.S. Patent No. 5,882,789, "the '789 patent"). Office Action, pages 3-4. In particular, the Examiner alleges that "Jones discloses a packaging material suitable for forming a heat sealable comprising a susceptor (column 7, line 47) and a carrier (column 7, lines 47-49) wherein said carrier and said susceptor are blended with one another and form a uniform mixture (column 7, lines 55-56), and wherein said susceptor is present in an amount effective to allow said composition to be induction heated by radio frequency energy (column 7, lines 33-40)." *Id.* at page 3. Applicants respectfully traverse the rejection.

The M.P.E.P. states that the Examiner bears the initial burden of establishing a *prima facie* case of obviousness under 35 U.S.C. § 103. M.P.E.P., 8th ed., §2142 (Rev. 2, May 2004). Moreover, it sets forth the criteria necessary to satisfy this burden:

> To establish a *prima facie* case of obviousness, three basic criteria *must* be met. First, there *must* be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there *must* be a reasonable expectation of success. Finally, the prior art reference (or references when combined) *must* teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success *must* both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP § 2143 - § 2143.03 for decisions pertinent to each of these criteria.

Id. (emphasis added).

Here, the Examiner has failed to set forth a *prima facie* case of obviousness under 35 U.S.C. §103 because the applied reference fails to teach or suggest all of the claim limitations. Claims 175-177 require the presence of a polar carrier in the claimed composition. However, the Examiner's reliance upon column 7, lines 47-49 in the '789 patent for a teaching of the polar carrier is mistaken. The referenced text pertains to polymers (ionomers and sealant materials), *not to polar carriers*. Applicants respectfully point out that their specification describes polar carriers (which are distinct from the ionomer), for example, at pages 29-32.

Hence, the Examiner has not set forth a *prima facie* case of obviousness under 35 U.S.C. §103. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the rejection.

III. Objections

Claims 167-168, 173-174 and 179-180 are objected to as being dependent upon a rejected base claim. Office Action, page 4.

Regarding claims 179-180, Applicants respectfully traverse the objection. These claims are ultimately dependent upon claim 175, which is only rejected under 35 U.S.C. §103, as described above. However, for the reasons described above (and wholly incorporated here) a *prima facie* case of obviousness was not set forth with respect to claim 175. Hence, Applicants respectfully ask that the Examiner reconsider and withdraw the objection of claims 179-180.

Regarding claims 167-168 and 173-174, Applicants respectfully request that the Examiner hold the objection in abeyance until all other issues have been resolved.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Water-Dispersible Adhesive Raw Materials For Non-Woven Assemblies

Richard A. Miller
Eastman Chemical Company

Abstract

Bonding with holt-melt adhesives poses some unique requirements to maintain bond integrity under a variety of end uses. The hot-melt adhesive industry has desired a water-dispersible raw material for a considerable amount of time. Previous attempts to satisfy this need were often deficient in both critical performance requirements and cost. Because regulatory changes are not driving this technology at present, adhesive manufacturers are reluctant to introduce products based on expensive raw materials. Thus, branched polyesters represents a "best of both worlds" compromise where water-dispersibility is provided, along with other unique attributes, without sacrificing the key application/performance profiles that the adhesive industry requires.

Eastman has developed branched water-dispersible polyester which, in addition to aqueous dispersions, may be used in the formulation of hot-melt adhesives for packaging, nonwovens, and other uses. Available in a range of viscosities (IVs), this material offers the following key features:

- 100% water-dispersible in ordinary tap water.
- Non-dispersible in ionic solutions
- Superior adhesion to Polyolefin films.
- Comparable key physical properties

Introduction

Hot-melt adhesives are useful for bonding various substrates such as wood, paper, plastics, nonwoven assemblies, textiles, and other materials. These applications call for high bond strength to resist shock, stress, high humidity, and extreme temperatures encountered in transportation and storage. In addition, the melt point, wetting time, initial tack, setting time, pot life, and general handling characteristics on automatic machinery are essential considerations. The hot melt industry has desired a water dispersible raw material for a considerable amount of time. In response to this need Eastman developed a family of water dispersible sulfopolyesters for use in hot melt and aqueous repulpable formulations. The properties and performance characteristics of these water dispersible polyesters will be described in this paper. Although these water dispersible raw materials were developed for use in packaging adhesives, the unique combination of properties renders these polymers suitable for non-woven applications.

Table 1

Physical Properties				
Production Status	Commercial	Commercial	Commercial	Commercial
Product Name	AQ 1045	AQ 1350	AQ 1950	AQ 14000
Brookfield Thermosel viscosity @ 177°C, cP (mPa·s)	3000-6000	28,000-45,000	80,000-110,000	300,000-500,000
Gardner colors (molten), max.	4	4	4	4
Physical form	Clear Solid	Clear Solid	Clear Solid	Clear Solid
Ring & ball softening point, °C (ASTM E 28)	80-90	100-110	110-120	125-140

Penetration hardness, dmm (ASTM D 5)	30	14	8	7
Tg (DSC), °C (ASTM D 3418)	-5	-2	3	7
Tensile strength, Mpa (ASTM D 412)	-	0.27	0.38	0.61
Elongation, %	1660	1600	1400	1200
Hydroxyl number	28	28	28	28
a Based on preliminary testing				
b Brookfield Thermosel Viscosity RVDV1+, 10 g of each sample conditioned at 90°C for 16 h in a vacuum oven prior to testing				

Table 2

Adhesive Performance of Branched Polyesters:*

Treated Substrate	Polyethylene	PET
AQ1045	50 g/mm	35 g/mm
AQ1350	87 g/mm	114 g/mm
AQ1950	97 g/mm	109 g/mm
AQ14000	68 g/mm	37 g/mm
* Heat sealed T-peel assemblies, ASTM D1876		

Technical Aspects of Polyesters

Eastman conventional water-dispersible polyesters are linear, amorphous materials comprised of aromatic acids and aliphatic glycols. Available in both pellet and dispersion form, they range in glass transition temperature (Tg) from 29° to 55°C.

Their water-dispersibility is due to the presence of pendent sodiosulfo groups randomly distributed along the polymer backbone. Incorporation of the ionic moieties is readily accomplished by copolymerization of 5-sodiosulfoisophthalate units into the polymer backbone. A = an aromatic dicarboxylic acid moiety G = an aliphatic or cycloaliphatic glycol residue OH = hydroxy end groups.

Figure 1

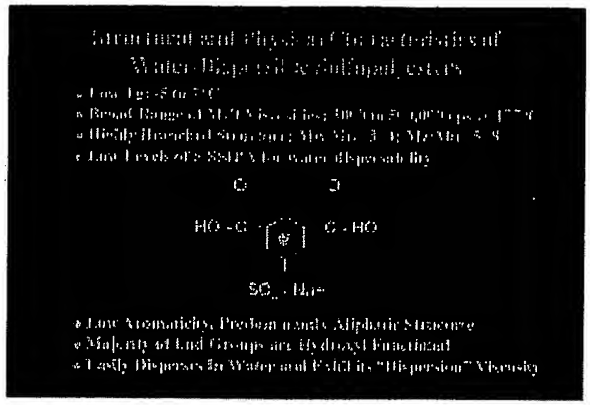
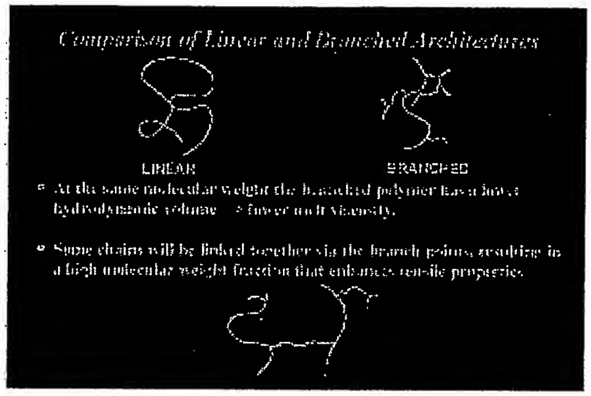


Figure 2



The following discussion covers the key differences in structure and properties between the branched polyester and conventional water-dispersible polyesters.

The unique properties of the new polyester are derived from a branched architecture and a specific combination of monomers resulting in a low Tg and enhanced compatibility with other resins. The low Tg provides, in part, the means by which water-dispersibility is readily obtained at or below room temperature, while the conventional water-dispersible polyesters are much more difficult to disperse.

The branched structure of the polyester results in low melt viscosity profiles that are required for hot-melt adhesive formulations. Potentially available in IV ranging from 0.2 to 0.65, the branched polyester exhibits melt viscosities ranging from 3000 cP to 400,000 cP at 177¢ C; a 0.3 IV branched polyester typically exhibits a viscosity of approximately 35,000 cP at 177¢ C. By comparison, the conventional water-dispersible polyester with a nominal IV of 0.3 will exhibit a melt viscosity of about 300,000 cP at 280¢ C, or over 1 million cP at 177¢ C. Since both types of material have the same IV, one might expect them to have the same molecular weight. However, their true molecular weights differ since branching most likely lowers the radius of gyration and thus decreases the hydrodynamic volume. Another aspect of molecular weight relates to distribution of chain lengths. It is likely that the low viscosity/good adhesive profile of the branched polyester results from a broader molecular weight distribution. On the one hand, there are large quantities of low molecular weight species to provide the lower melt viscosities, but there are also more of the very high molecular weight species that are most likely yielding the good adhesion and satisfactory tensile properties. This is quantitatively illustrated by the molecular weight distributions (MWD) that were obtained from GPC analysis using PET standards; a linear analog of similar composition showed a polydispersity (Mw/Mn) of 2.3, while the branched polyester samples were in the 3.5 -4 ranges. An even more striking emphasis of this point is gained when the very high molecular weight fractions, known as Mz or the z-average molecular weight, are compared to Mn. As before, GPC analysis was used to obtain the data. For the linear and branched materials, Mz/Mn values of 4.8 and 9 - 10 were obtained, respectively. It is generally known that a high Mz/Mn is indicative of a branched material. A summary of the molecular weight distribution data is found in Table 2.

Table 3

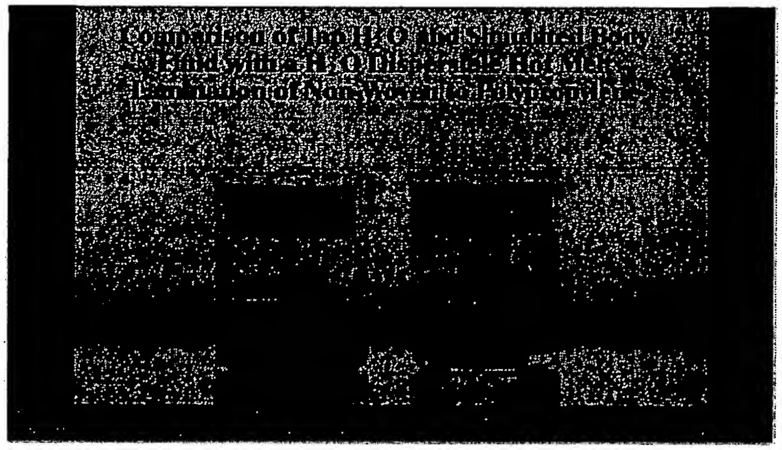
Comparison of molecular weight distribution data

Architecture	Mw/Mn	Mz/Mn
Linear	2.3	4.8
Branched	* 3.5 – 4	9 – 10

* Data is a range taken from several sample runs

Product function: These products are inherently water-dispersible due to the random incorporation of 5-sodiosulfoisophthalate units within the polyester backbone. The compatibility with a range of commonly employed hydrophobic raw materials, such as acid functional and /or aromatic or cyclic structure tackifying resins, glycol-containing oils, or cyclo aliphatic plasticizer, allows for a variety of hot-melt adhesives to be formulated. These finished adhesives are then rendered water-dispersible by the efficacy of the branched polyester as a surfactant. The recyclability or flushability of

Figure 3



non-woven adhesively bonded articles are enhanced; for example, a disposable diaper in a waste treatment environment process is not affected by the presence of insoluble masses of adhesive. The uniqueness of this branched polyester stems from its tailored molecular architecture. A proprietary process has allowed a highly branched structure to be manufactured within narrow ranges of melt viscosities. This results in a broad molecular weight distribution where there are enough low molecular weight fractions to provide the low melt viscosities, while at the other end of the spectrum there are sufficient numbers of high molecular weight species to give the tensile and adhesive properties that are needed. Another key breakthrough was the discover of a monomer composition that did not just lower the glass transition (Tg) to alleviate the brittleness problem, but also provided a high ring and ball softening point. Finally, the same ionic nature of this branched polyester that results in water-dispersibility also prevents solubility in ion-containing body fluids.

Principal applications

This product is being targeted toward large volume applications, where we have found indications of broad utility.

Non-woven product assemblies

- A variety of disposable products, such as diapers, sanitary napkins, and incontinent briefs would be more environmentally friendly if a water-dispersible hot-melt adhesive could be used. For example, a branched polyester (0.31V) quickly dissolves into a compost pile; this would facilitate the breakup of a diaper assembly and

hasten the degradation by virtue of the more rapid increase in surface area. Another example could be the design of a "flushable" sanitary napkin. Once again, the assembly would undergo fragmentation more rapidly, which, in turn, would hasten degradation. It would be an understatement to say that the non-dispersibility of branched polyesters in body fluids (urine, sweat) is an essential innovation characteristic to spur these types of product developments.

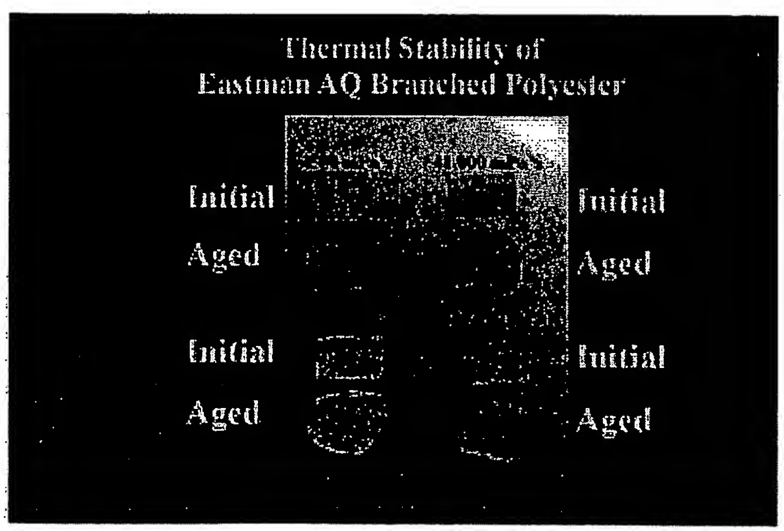
Explanation for dispersibility on sulfopolyesters in tap water and non-dispersibility in body fluid. The sudiosulfo groups introduce charged functionalities that electrostatically stabilize the polymer molecule in pure water. The remainder of the sulfopolyester, although relatively polar, is not inherently water-soluble. Because the ionic groups are randomly distributed along the backbone, it is unlikely that a classical micelle structure is formed where all the charged groups reside on the surface of a particle with the hydrophobic segments occupying the inferior. Sulfopolyesters are not known to form true solutions, but rather exist as dispersions of particles in water. Therefore, it is reasonable to expect that the surface of the particles would contain a greater proportion of the ionic groups to provide water dispersibility. The discrete particle phase is a key to the non-dispersibility in saline solutions, because adding salt to the water in essence causes the water to become a poorer solvent for the sulfopolyester. Adding ionic species to the water will invoke a situation of electrostatic repulsion where the polymer particles will have no driving force to form dispersion. Viewing this situation from the opposite perspective where the polymer would be already dispersed and salt then added to the aqueous medium, it would be possible to precipitate out the polymer. Thus, ionic strength may be used as tunable solubility mechanism for recovery of the dispersed polymer. Increasing the ionic strength of the aqueous medium to a high enough level will cause the polymer particles to overcome their repulsion, coagulate, and form a separate phase.

Incorporation into Adhesive Formulations

This unique branched polyester can be combined with a wide range of other commonly used adhesive raw materials. The tackifying resins useful in adhesive compositions are generally polar in nature and have a Ring and Ball Softening Point greater than 80¢ C. Water-dispersibility and compatibility with a variety of tackifying resins/rosins were evaluated. Results indicate excellent compatibility with resins/rosins with aromatic, cycloalphatic, or highly acid functional chemical structures. Various plasticizing or extending oils may be incorporated into the base polyester. Compatible plasticizer includes white mineral oils and benzoate plasticizer, such as dipropylene glycol dibenzoateand 1,4-Cyclohexane dimethanol dibenzoate.

Among the applicable stabilizers or antioxidants that may be used are high molecular weight hindered phenols and multifunctional phenols such as sulfur and those containing phosphorous. The water-dispersible branched polyester is manufactured with both primary and secondary antioxidants.

Figure 4



Thermal Stability of Eastman Branched Polyester

The following tables demonstrate the formulation versatilely with these sulfopolyesters, in a variety of end use applications.

Table 6

Nonwoven Adhesive

AQ1350	60%
Plasticizer	5%
Rosin Ester	35%
Viscosity @ 275F	19,350cp
Viscosity @ 285F	12,700cp
Viscosity @ 300F	8012cp
RBSP°C	87
PE to PE Adhesion	42g/mm

Table 7

Pressure Sensitive Adhesive

AQ14000	60%
Rosin Ester	20%
Plasticizer	20%
Viscosity	4000 cps
RBSP	78° C
90° Quick Tack	140 g/mm
180° Peel Adhesion	80 g/mm
RT Hold Power	22 hrs

Results and Conclusions:

The results of this study indicated that the water dispersible polyesters should find considerable utility in a wide variety of recyclable aqueous and hot melt adhesive applications. Preliminary formulations have been identified for nonwoven assemblies, and pressure sensitive applications. In each of these areas, the water dispersible polyesters provide for a unique combination of performance including water dispersibility in neutral or alkaline conditions yet not dispersible in ionic solutions such as body fluids.

References

Optimization of Hot Melt Adhesives Using Water Dispersible Polyesters, Richard A Miller and Gregg. Althen, Proceedings of the TAPPI Hot Melt Adhesive Seminar 1996.

Eastman AQ Branched Polyester a New Water-Dispersible Adhesive Raw Material, Richard A Miller and Dr.Scott George, the Journal of the Adhesive and Sealant Council, Inc., Vol.XXVI, No.1, 1195.

Miller et al. US 5,543,488 Water Dispersible Adhesive Composition and Process

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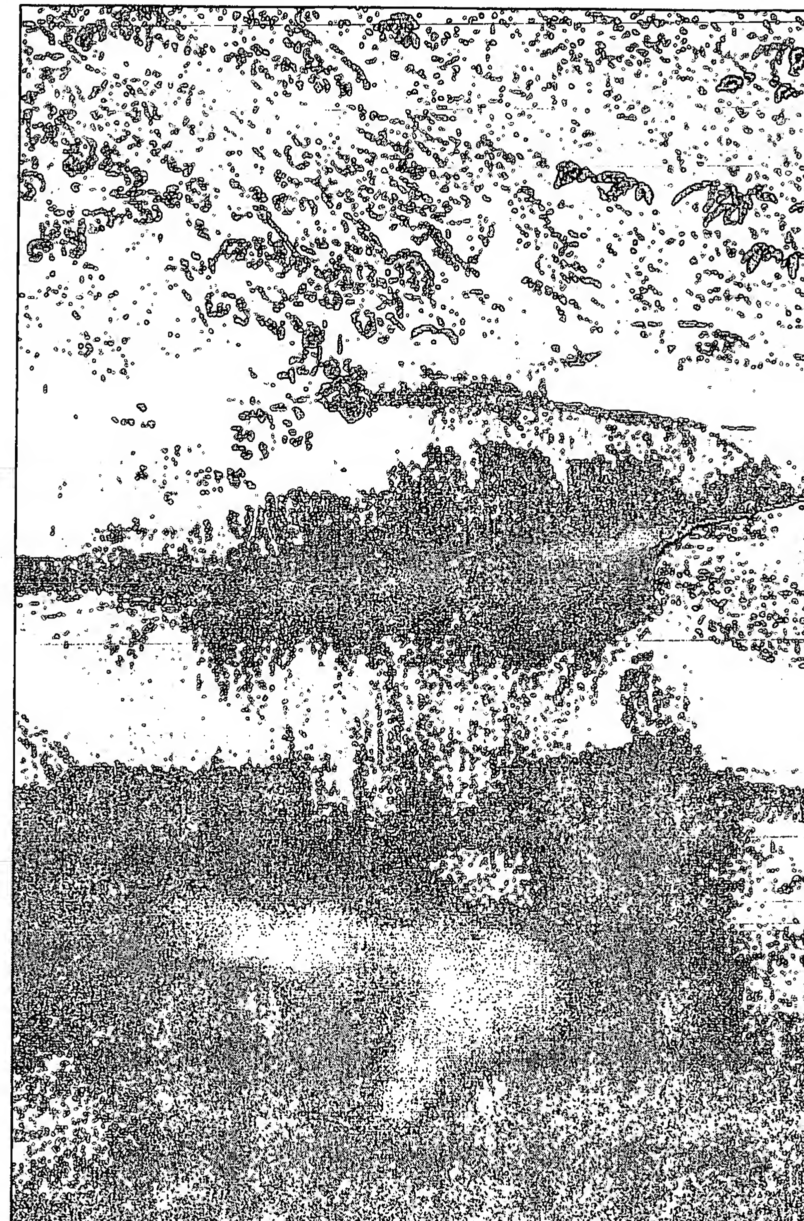
Eastman AQ Branched Polyesters

New Hot-Melt Adhesive Raw Materials That Are Water Dispersible



EASTMAN

Tennessee Eastman Division, Kingsport, Tennessee

Eastman AQ Branched Polyesters

New Hot-Melt Adhesive Raw Materials That Are Water-Dispersible

Eastman AQ branched sulfopolyesters are unique hot-melt adhesive raw materials that are water-dispersible and are useful as base or modifying polymers in hot-melt applications. Recycling processes increasingly require substrates to be bonded with hot-melt adhesives that will separate readily in an aqueous environment. Polyolefin-based adhesives, especially polyethylene and amorphous polypropylene systems, are separable only by physical means due to their low densities compared to water.

There is also a need for hot-melt adhesives that will disperse in an aqueous environment. Eastman Chemical Company's proprietary sulfopolyesters are water-dispersible and applicable to a variety of applications, including packaging and nonwovens. The primary feature of *Eastman AQ* branched polyesters is their dispersibility in water, coupled with inherent nondispersibility in ionic (saline) solutions, while maintaining good adhesive performance characteristics. These amorphous copolyesters are thermoplastic, rather than thermosetting, and are, therefore, remeltable, which results in their utility for heat-sealable substrate bonding. Eastman's commercial product line offers adhesive formulators a range of melt viscosities from 4,500–400,000 cP. *Eastman AQ* branched polyesters are compatible with a variety of hydrophobic polar ingredients, such as tackifiers, resins, extending oils, and plasticizers, for formulating water-dispersible adhesives. These finished adhesives are then rendered water-dispersible by the efficacy of the sulfopolyester as a surfactant.

Key Benefits

- Easily formulated with a variety of tackifiers, waxes, and plasticizers to meet customer needs
- 100% water-dispersible
- Repulpable under neutral and alkaline conditions
- Wide range of viscosities
- Compatibility with polar ingredients
- Regulated by FDA at 21 CFR 175.105 for use in food-packaging adhesives
- Excellent adhesion to polyolefin substrates
- Nonirritant
- Nondispersible in ionic solutions
- Commercially available
- On TSCA inventory

Table 1 Physical Properties

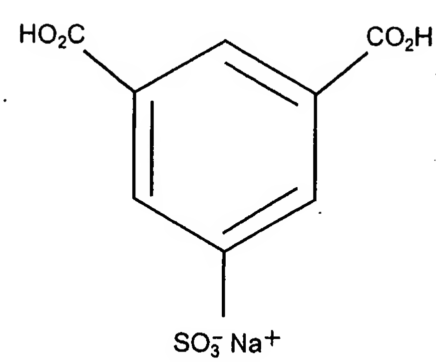
Typical Properties[a]	Production Status/Name			
	Commercial AQ 1045	Commercial AQ 1350	Commercial AQ 1950	Commercial AQ 14000
Brookfield Thermosel viscosity @ 177°C, cP (mPa·s)	4,500	35,000	95,000	400,000
Gardner color (molten), max.	4	4	4	4
Physical form	Clear solid	Clear solid	Clear solid	Clear solid
Ring and ball softening point, °C (ASTM E 28)	85	105	115	133
Penetration hardness, dmm (ASTM D 5)	30	14	8	7
T_g (DSC), °C (ASTM D 3418)	−5	−2	3	7
Tensile strength, MPa (ASTM D 412)	—	0.27	0.38	0.61
Elongation, %	1,660	1,600	1,400	1,200
Hydroxyl number	28	28	28	28

[a]*Based on preliminary testing. Properties are typical of average lots. Eastman makes no representation that the properties in any given lot will conform exactly to the listed values.*
[b]Brookfield *Thermosel viscosity RVDV1+, 10 g of each sample conditioned at 90°C for 16 h in a vacuum oven prior to testing*

Technical Aspects of Polyesters

Eastman AQ water-dispersible polyesters are branched, amorphous materials composed of difunctional acids and various glycols. Their water-dispersibility is due to the presence of pendant sodiosulfo groups randomly distributed along the polymer backbone. Incorporation of the ionic moieties is readily accomplished by the copolymerization of 5-sodiosulfoisophthalic acid (see Figure 1) into the polymer backbone.

Figure 1 5-Sodiosulfoisophthalic Acid



The unique properties of the new polyesters stem from a branched architecture and a specific combination of monomers, resulting in a low T_g and enhanced compatibility with other resins. The branched structure of the polyesters results in low melt viscosities required for hot-melt adhesive formulations.

Applications

Case/Carton Closing—Using the key criteria of low viscosity and fast set time, a starting-point formulation using *Eastman AQ* 1045 polyester as the base polymer was identified. It is compared to conventional EVA- and PE-based adhesives in Table 2. The water-dispersible polyester-based formulation compared favorably to the performance characteristics of the conventional adhesives for elevated-temperature performance and setting characteristics. As noted, *Eastman AQ* 1045 is 100% repulpable in neutral or alkaline conditions.

Multiwall Bags—A formulation using *Eastman AQ* 1950 polyester as the base material was identified for use in multiwall bag end seam applications. This formulation is compared to a typical PE-based adhesive in Table 3. Again, the polyester-based composition compared favorably to the conventional adhesive in elevated-temperature performance, yet it is fully repulpable under alkaline conditions. This makes the polyester-based formulation ideally suited for such applications as beater bags.

PET Bottle Label Adhesive—Formulations using *Eastman AQ* 1045 polyester should find use for PET bottle labeling. A formulation with many desirable properties for a label adhesive is shown in Table 4. This formulation demonstrates excellent adhesion to PET and good bond strength at 120°F and at 35°F, low ring and ball softening point, and low viscosity at application temperature. This formulation is also completely dispersible in neutral and alkaline repulping conditions.

Nonwoven Product Assembly Adhesive—*Eastman AQ* 1350 is beneficial in nonwoven applications. A starting formulation is shown in Table 5. The polyester formulation has excellent adhesion to polyethylene films, *Brookfield* Thermosel viscosity between 1,000–2,000 cP at 177°C, and a low ring and ball softening point of 77°C. Because of the polyester's nondispersibility in ionic solutions such as body fluids, it should provide superior performance in nonwoven applications. This formulation is fully repulpable in alkaline conditions.

Pressure-Sensitive Adhesives—*Eastman AQ* water-dispersible polyesters should also benefit pressure-sensitive adhesive applications. As shown in Table 6, they can be modified to exhibit high levels of tack and moderate holding power. These formulas also have good adhesion to polyethylene, polypropylene, and exceptional adhesion to PET. They also exhibit fiber-tearing quick tack to paper substrates. In repulpability tests, the two-component combination of *Eastman AQ* 1350 and *Benzoflex* 9-88 was completely repulpable in all conditions; the three-component formula using *Eastman AQ* 14000, *Staybelite* resin, and *Benzoflex* 9-88 was 70% repulpable in neutral conditions and completely repulpable in alkaline conditions.

Additional pressure-sensitive adhesive applications based on these branched sulfopolyesters include medical tapes that are removable by water but are resistant to ionic fluid such as perspiration.

Table 2 Hot-Melt Packaging Formulations

Eastman AQ Formulations	Wt %	EVA- and PE-Based Hot Melts	Wt %	Wt %
Eastman AQ 1045	60.0	Typical EVA	100	—
Nevex 100	31.0	Typical PE	—	100
Benzoflex 352	8.7		—	—
Irganox 1010	0.1		—	—
Cyanox 1212	0.2		—	—
Viscosity @ 177°C, cP (ASTM D 3236)	1,125		900	960
Set time, s	3.1		1.7	2.6
SAFT, °C	75		96	92
PAFT, °C	40		58	65
Repulpability, alkaline conditions,[a] %	100		NA	NA
RBSP, °C (ASTM E 28)	84		112	108

[a] *73°F, pH of 11*

Figure 2 indicates thermal color stability of each *Eastman AQ* branched polyester after samples were aged at 80°C for 100 hours in a forced-air oven. This photo shows the excellent thermal stability of these polyesters. *Eastman AQ* branched polyesters contain both primary and secondary antioxidants.

Figure 3 shows the resistance of *Eastman AQ* 1350 polyester to ionic solutions. This photo depicts two beakers, one filled with tap water, the other filled with 0.2-M ionic solution similar to human body fluids. Dyed *Eastman AQ* 1350 laminated onto nonwoven material was placed in each beaker for 8 hours. The tap water readily dispersed the polyester, while in the ionic solution the AQ 1350 remained nondispersible.

Figure 2 Thermal Stability of *Eastman AQ* Branched Polyesters

AQ 1045 **AQ 1350** **AQ 1950** **AQ 14000**

Initial Initial Initial

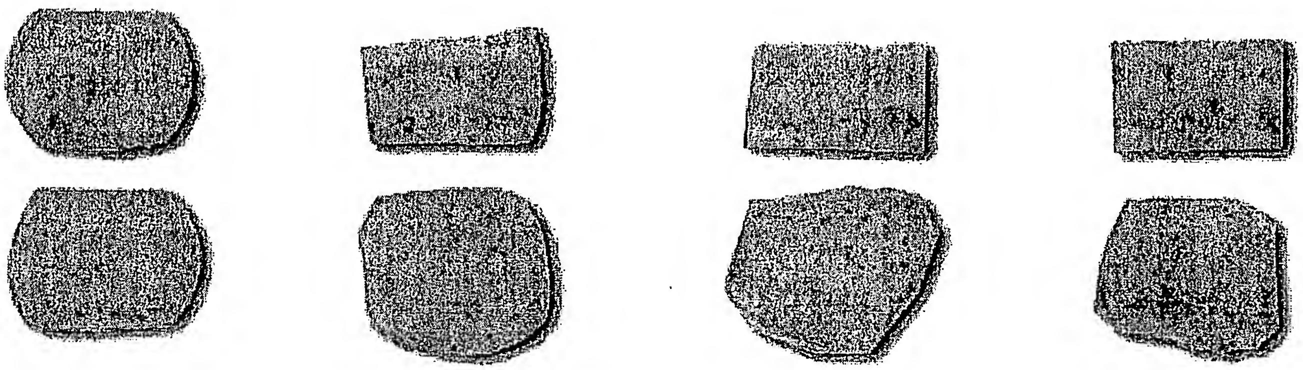


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Figure 3 Ionic Solution Stability of *Eastman AQ* Branched Polyesters

Table 3 Hot-Melt Multiwall Bag Adhesive Formulations

Eastman AQ Formulation	Wt %	PE-Based Hot Melt	Wt %
Eastman AQ 1950	70.0	Typical PE	—
Nevex 100	20.0		100
Benzoflex 352	9.7		—
Irganox 1010	0.3		—
Viscosity @ 177°C, cP	18,450		32,100
RBSP, °C	102		106
SAFT, °C	85		99
PAFT, °C	60		68
Repulpability, alkaline conditions,[a] %	100		NA

[a] 73°F, pH of 11

Table 4 PET Label Adhesive Formulation Using *Eastman AQ* 1045

Ingredients	Wt %
Eastman AQ 1045	60.0
Staybelite acid rosin tackifier	26.7
Benzoflex 9-88 plasticizer	13.0
Irganox 1010 antioxidant	0.3
Test Properties	
180° peel, steel, g/mm	38
T-peel adhesion to PET, g/mm	42
90° quick tack, g/mm	15
Room temp hold power, 1 kg, 1 in.^{2}, 25°C, min	4
Ring and ball softening point, °C	62
Brookfield Thermosel viscosity, 177°C, cP	430
Repulpability, neutral conditions,[a] %	100
Repulpability, alkaline conditions,[b] %	100

[a] 73°F, pH of 7
[b] 73°F, pH of 11

Table 5 Nonwoven Product Assembly Adhesive Using *Eastman AQ* 1350

Ingredients	Wt %
Eastman AQ 1350	60.0
Staybelite acid rosin tackifier	34.7
Benzoflex 9-88 plasticizer	5.0
Irganox 1010 antioxidant	0.3

Test Properties	
180° peel adhesion, g/mm	60
T-peel adhesion to PE, g/mm	42
90° quick tack, g/mm	1.3
Room temp hold power, 1 kg, 1 in.^{2}, 25°C, min	1,300
Ring and ball softening point, °C	77
Brookfield Thermosel viscosity, 177°C, cP	1,120
Repulpability, alkaline conditions,[a] %	100

[a] 73°F, pH of 11

Table 6 Pressure-Sensitive Adhesives Using *Eastman AQ* Water-Dispersible Polyesters

Ingredients	Wt %	
Eastman AQ 1350	94.7	—
Eastman AQ 14000	—	69.7
Staybelite acid rosin tackifier	—	10.0
Benzoflex 9-88 plasticizer	5.0	20.0
Irganox 1010 antioxidant	0.3	0.3

Test Properties		
180° peel adhesion, g/mm		
Steel	145	60
Polyethylene		12
Polypropylene		29
PET		116
90° quick tack		
Steel	30	67
Bond paper		14
Copy paper		17
Kraft paper		18
Room temp hold power, 1 kg, 1 in.^{2}, 25°C, min	2,000	1,800
Ring and ball softening point, °C	96	94
Brookfield Thermosel viscosity, 177°C, cP	22,000	21,000
Repulpability, neutral conditions,[a] %	100	70
Repulpability, alkaline conditions,[b] %	100	100

[a]73°F, pH of 7
[b]73°F, pH of 11

List of Suppliers

Eastman AQ 1045, a 4,500-cP melt viscosity water-dispersible branched polyester	Eastman Chemical Company
Eastman AQ 1350, a 35,000-cP melt viscosity water-dispersible branched polyester	Eastman Chemical Company
Eastman AQ 1950, a 95,000-cP melt viscosity water-dispersible branched polyester	Eastman Chemical Company
Eastman AQ 14000, a 400,000-cP melt viscosity water-dispersible branched polyester	Eastman Chemical Company
Staybelite acid rosin tackifier	Hercules Chemical Company Wilmington, Delaware
Nevex 100 aromatic tackifier	Neville Chemical Company Pittsburgh, Pennsylvania
Benzoflex 352 solid benzoate ester plasticizer Corporation	Velsicol Chemical
Benzoflex 9-88 liquid benzoate plasticizer Corporation	Velsicol Chemical
Irganox 1010 hindered phenol antioxidant	Ciba-Geigy
Cyanox 1212 secondary antioxidant	American Cyanamid

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